Technology Opportunity

High Temperature Vapor Phase Lubrication

As a result of a joint NASA/CSU effort, a new high-temperature lubrication method has been developed.

Potential Commercial Uses

- In aircraft employing new gas turbine engine lubrication designs
- For lubrication of heavy duty ground vehicles
- As a replacement for traditional lubricants in the metal processing industries, such as forging plants

Benefits

- Increases the operating temperature of heat engines thus improving efficiency
- Eliminates the oil sump and recirculation hardware in an engine
- Needs only a small amount of vapor phase lubricant in a once-through system
- Prevents pollution by eliminating the disposal of huge amounts of waste oil
- Decreases workers exposure to graphite and related lubricants in the metal processing industry

The Technology

Many components of future aircraft will be constructed from novel high-temperature materials, such as superalloys and ceramic composites, in order to meet the high operating temperatures desired by the designers. Many of these materials will have to be lubricated during operation. Current state-of-the-art formulated esters lubricate successfully only up to 200 °C, and operating temperatures in excess of 300 °C are expected. There are no known liquids that can lubricate above 300 °C without significant decomposition.

A novel, alternative method of lubrication, called vapor phase lubrication, was investigated by the combined efforts of the Surface Science Branch of NASA Lewis and the Chemical Engineering Department of Cleveland State University. In this method a small amount of an organic liquid (0.014% by weight in air) is vaporized into a flowing air stream, and the air stream is directed to the sliding surfaces where lubrication is needed. The vaporized organic substance reacts at the sliding surfaces,

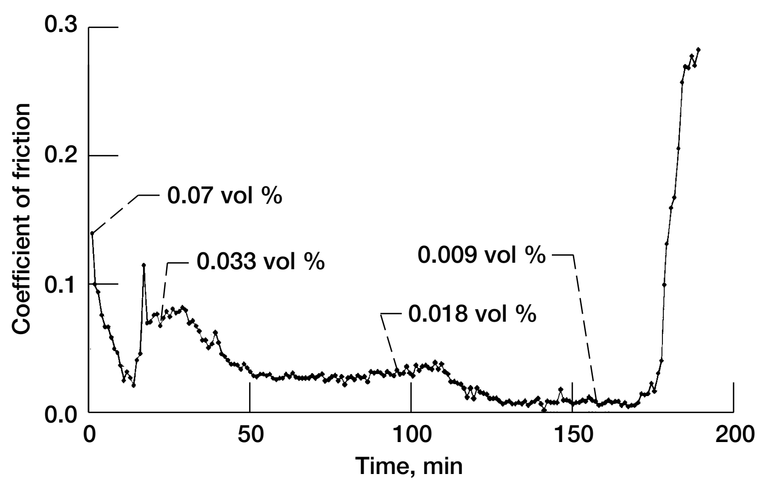

Figure 1.—Coefficient of friction vs. time for various concentrations of thioether in air on cast iron (plate temperature, 500 °C; vapor temperature, 400 °C; load, 4 kg).

thereby depositing a thin, lubricious, semisolid film. A number of tribological studies were conducted in a high-temperature, friction and wear apparatus modified for vapor phase lubrication by using a phosphate ester or a thioether as the vapor phase lubricant. A typical test consisted of loading a cast-iron rod against a reciprocating cast-iron plate (which generated a contact pressure of 1.2 MPa) at 500 °C. Vapor phase lubrication of this system led to the deposit of a thin film which reduced the frictional coefficient of the sliding surfaces to values as low as 0.01 with no detectable wear of the surfaces.

Viking Forge (Aurora, OH) is currently testing a form of vapor phase lubrication in their forging plant as a replacement for the graphite lubricant that is commonly used by the metal processing industry.

Options for Commercialization

There appears to be significant commercialization potential for vapor phase lubrication. The aerospace and metal processing industries are examples of two industries that can benefit from vapor phase lubrication. Applications have been submitted for two patents. CSU (Dr. Earl Graham) and Dr. Wilfredo Morales (NASA) are the co-inventors.

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Key Words

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